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NASA-02330 (June 2004)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA

Superseding NASA-02330 (May 2004)

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NASA-02330 (June 2004)
NATIONAL AERONAUTICS **NASA**
AND SPACE ADMINISTRATION **Superseding NASA-02330**
(May 2004)

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SECTION 02330

EMBANKMENT
06/04

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers excavating, grading, and associated operations that may be required covering roads, streets, airfields, parking, and storage areas. There are certain operations and items of construction that may be omitted as not being applicable to the particular work under consideration, or may, for certain reasons, be performed as independent operations or as subsidiary operations. Any portions of the provisions of this section covering the various work items which are not applicable to the work under consideration or can be more expeditiously or advantageously performed under other contracts, in the opinion of the Contracting Officer, will be deleted. This section or any other section affected will be revised to fit local conditions.

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PART 1 GENERAL

1.1 REFERENCES

****

NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

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The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 145	(1991; R 2003) Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

AASHTO T 180	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 2	(2000) Sampling of Aggregates
AASHTO T 87	(1986; R 2000) the Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	(2000) Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2922	(2001) Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3282	(1993; R 1997e1) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 422	(2002) Standard Test Method for Particle-Size Analysis of Soils
ASTM D 4318	(2000) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	(2001) Safety and Health Regulations for Construction

1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

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The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Construction equipment list shall be submitted.

Contractor shall record Existing Conditions prior to starting work in accordance with the paragraph entitled, "Existing Conditions," of this section.

Location of Utilities
Location of Tests
Location of Inspection
Location of Approved Utilities

A protection plan shall be submitted by the Contractor verifying the Existing Utilities left in place.

SD-06 Test Reports

Test reports shall be submitted by the Contractor for Soil Test within 5 calendar days of test date. Soil test shall comply with paragraph entitled, "Quality Control Testing During Construction."

SD-07 Certificates

Certificates of compliance for Proposed Soil Materials shall be submitted in accordance with paragraph entitled, "Tests for Proposed Soil Materials."

1.3 DEFINITIONS

1.3.1 Soil Materials

Cohesionless soil materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Moisture-density relations of compacted cohesionless soils when plotted on graphs will show straight lines or reverse-shaped moisture-density curves.

Cohesive soil materials include clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands. Moisture density relations of compacted cohesive soils when plotted on graphs will show normal moisture-density curves.

1.3.2 Subgrade

Subgrade shall mean the top surface of a backfill or fill or the uppermost surface of an excavation, graded to conform to the required subgrade elevation and compacted to densities indicated.

1.3.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure in AASHTO T 180, Method B or D.

1.3.4 Classified Excavation

Separate consideration will be given to the nature of the materials excavated, in accordance with the following designations and classifications.

1.3.4.1 Rock Excavation

Rock excavation shall include blasting, excavating, grading, and disposing of material classified as rock and shall include the satisfactory removal and disposition of boulders 1/2-cubic yard .4 cubic meter or more in volume; solid rock; rock material in ledges, bedded deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; and conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock that is impossible to remove without systematic drilling and blasting. The removal of any concrete or masonry structures, except pavements, exceeding 1/2-cubic yard .4 cubic meter in volume that may be encountered in the work shall be included in this classification. If at any time, including during the excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, such material shall be uncovered and classified. The Contractor shall not proceed with the excavation of this material until the material has been classified as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to obtain a classification of the undisturbed surface will cause the forfeiture of the Contractor's right of claim.

1.3.4.2 Common Excavation

Common excavation shall include the satisfactory removal and disposition of materials not classified as rock excavation.

1.3.5 Unclassified Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4 SAMPLING AND TESTING

1.4.1 Soil Test and Inspection Service

****
NOTE: Delete the first of the following paragraphs when soil testing shall be provided by the Contractor. Delete the second paragraph when soil testing will be provided by the Government.
****

[Soil testing service will be provided by the Government. Testing service will include testing soil materials proposed for use in the work and field-testing facilities for quality control testing during construction period.]

[Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials, sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.]

1.4.2 Tests for Proposed Soil Materials

Soil materials proposed for use in the work shall be tested. The materials shall be approved by the Contracting Officer prior to start of work as follows:

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satisfactory soil materials	Sampling	AASHTO T 2	One for each source of materials to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Preparation of samples	AASHTO T 87	
	Sieve analysis of fine and coarse aggregate	ASTM C 136	
	Mechanical analysis of soils	ASTM D 422	
	Liquid limit of soils	ASTM D 4318	
	Plastic limit and plasticity index of soils	ASTM D 4318	
	Moisture-density relations of soil	AASHTO T 180, Method B or D	

1.4.3 Quality Control Testing During Construction

Soil Test on materials shall be performed during construction as follows:

MATERIAL	REQUIREMENT	TEST METHOD	MATERIAL TESTED AND NUMBER OF TESTS
Soil material-in-place after compaction	Density of soil-in-place	ASTM D 1556 Sand Cone Method or ASTM D 2922 Nuclear Method	At least three daily for each subgrade soil material, and for each layer of soil material; additional tests whenever there is any change in moisture

1.4.4 Field Testing Facilities at Subbase Mixing Plant

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NOTE: Delete the first of the following paragraphs when soil testing shall be provided by the Contractor. Delete the second of the following paragraphs when soil testing will be provided by the Government.

Delete paragraph heading and the following paragraphs if plant mixed subbase course material is not required.

****

[Field-testing facilities for the purpose of testing subbase course material at the mixing plant will be provided by the Government.]

[Field-testing facilities for the purpose of testing subbase course material at the mixing plant shall be provided by the Contractor's soil-testing service.]

1.4.5 Reports

[No soil material shall be used until soil test reports have been reviewed and approved.]

1.4.6 Evaluation of Test Results

Soil materials of any classification shall not have a moisture content at the time of compaction that would be classified as unsatisfactory soil materials in the paragraph entitled, "Definitions."

Results of density of soil-in-place tests shall be considered satisfactory if the average of any group of four consecutive density tests which may be selected is in each instance equal to or greater than the specified density, and if no density test has a value more than 2 percentage points below the specified density.

1.5 USE OF EXPLOSIVES

[Explosives shall not be used or brought to the project site without prior written approval. Such approval shall not be construed as relieving the Contractor of responsibility for injury to persons or for damage to property due to blasting operations. Blasting shall be performed by skilled personnel in accordance with governing authorities and as approved. Minimum safety requirements for blasting shall be in accordance with OSHA Regulations 29 CFR 1926, Subpart U.]

[The use of explosives will not be permitted.]

1.6 PROTECTION OF PERSONS AND PROPERTY

Excavations shall be barricaded and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

Structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations shall be protected against damage including settlement, lateral movement, undermining, and washout.

Topsoil removal operations shall be conducted to ensure safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

1.7 Construction Equipment List

Construction Equipment List for all major equipment to be used in this sections shall be submitted to the Contracting Officer prior to start of work.

1.8 Existing Conditions

Records of Existing Conditions shall be submitted by the Contractor prior to the start of work. The Contractor shall verify the existing conditions are correct as shown on the plans and described in the specifications. The Contracting Officer shall be notified immediately if any discrepancies are found.

Records of underground utilities Location of Utilities, Location of Inspection, Location of Tests and Location of Approved Utilities shall be submitted to the Contracting Officer prior to start of work.

PART 2 PRODUCTS

2.1 SATISFACTORY MATERIALS

Satisfactory materials shall mean AASHTO M 145 (ASTM D 3282), Soil Classification Groups A-1, A-2-4, A-2-5, and A-3.

2.2 UNSATISFACTORY MATERIALS

Unsatisfactory materials shall mean AASHTO M 145, Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7, peat and other highly organic soils, and soil materials of any classification that have a moisture content, at the time of compaction, beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

2.3 TOPSOIL

Topsoil shall be any soil removed from the project site which consists of clay or sandy loam. The topsoil shall be reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, roots, and other objectionable material larger than 2 inches 50 millimeter in any dimension.

2.4 COMPOST

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NOTE: Insert grade or class of compost suitable for the surface required. Insert local or state regulation defining class or grade of compost. Where local or state regulations do not define grade or class, insert requirements for screening to limit particle size.

****

[Compost shall be yard trimmings or yard waste compost processed and graded according to state and local regulations.]

[Compost shall be grade [_____] as defined by [_____].]

2.5 TOPSOIL BLEND

Where insufficient topsoil is removed from the project site for later reuse, the topsoil removed shall be stockpiled and blended with compost at the site to achieve the required volume.

PART 3 EXECUTION

3.1 BLASTING

[Where explosives are used in rock excavation, the charges shall be so proportioned and placed that they will not loosen the rock outside the excavation lines indicated, or as specified. Contractor shall remove, at no additional cost, any material outside the authorized cross section that may be shattered or loosened by blasting.]

[Blasting is not required.]

3.2 CONSERVATION OF TOPSOIL

****
NOTE: Topsoil will be separately excavated, stored, and used for surface finish in preparation for seeding, sodding, or other planting only where topsoil is definitely superior for grass and plant growth as compared to the remainder of the excavated material. Surface soil that is a heavy clay, predominantly sandy, or is lean in grass and plant-growth qualities will not be saved. The hauling, spreading, smoothing, and maintenance of the topsoil in preparation for the seeding and planting operations are generally considered separate projects which will normally be handled under a separate contract and therefore are not considered in this specification. Change the number of inches millimeter to meet project conditions.
****

Topsoil shall be stripped to a depth of not less than 4 inches 100 millimeter; when stored it shall be kept separate from other excavated materials, free of roots, stones, and other undesirable materials. Where indicated, topsoil shall be removed without contamination with subsoil and spread on areas already graded and prepared for topsoil, or when so specified, topsoil shall be transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later or at locations indicated or specified by the Contracting Officer. Topsoil blend shall be used on all embankments when there is not enough topsoil available.

3.3 EXCAVATION

Excavations specified shall be done on either a classified or unclassified basis as provided for under the item designations of the Contract.

Contractor shall perform excavation of every type of material encountered by cutting accurately to the cross sections to the lines, grades, and elevations indicated. Grading shall be in conformity with the typical sections indicated and the tolerances specified in paragraph entitled, "Finishing."

Satisfactory excavated materials shall be transported to and placed in fill or embankment areas within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Surplus satisfactory excavated material not required for fill or embankment shall

be disposed in areas approved for surplus materials storage or designated waste areas. Unsatisfactory excavated material shall be disposed in designated waste or spoil areas. During construction, excavation and filling shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contracting Officer.

3.3.1 Excavation of Ditches, Gutters, and Channels

Care shall be taken not to excavate ditches and gutters below grades shown. Excessive open-ditch or gutter excavation shall be backfilled with suitable materials to grades indicated at no additional cost. Materials excavated shall be disposed as indicated, except that in no case shall material be deposited less than 3 feet 1 meter from the edge of a ditch. Contractor shall maintain excavations free from debris until final acceptance of the work.

3.3.2 Excavation for Drainage Structures

Dimensions and elevations of footings and foundation excavations indicated are only approximate and may be changed if necessary to ensure adequate foundation support. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm surface, either level, stepped, or serrated. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before concrete or masonry is to be placed.

****

NOTE: The following paragraph will not be retained except where pile foundations are to be used. If pile foundations are used on a specific job, the following paragraph will become a part of the specification.

****

Where pile foundations are to be used, the excavation of each pit shall be stopped at an elevation 1 foot 300 millimeter above the base of the footing, as specified, before piles are driven. After pile driving has been completed, loose and displaced material shall be removed and excavation completed, leaving a smooth, solid, undisturbed surface to receive concrete or masonry.

3.3.3 Protection or Removal of Utility Lines

Existing Utilities that are indicated to be retained, or the locations of which have been ascertained from Government utility drawings, as well as utility lines encountered during excavation, shall be protected from damage during excavation and backfilling. However, reliance on the information obtained from Government drawings does not absolve the Contractor of responsibility for damages, so careful hand methods shall be used to verify the location of underground utilities. Damage shall be reported immediately and satisfactorily repaired by the Contractor at no additional cost. The Contractor shall provide sketches of existing conditions if

there are variances, as well as any modifications, on "as-built" drawings. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall give notice in ample time for the necessary measures to be taken to prevent interruption of service.

3.4 CLASSIFICATION OF EXCAVATION

Excavations specified shall be done on either a classified or unclassified basis as provided for under the item designations of the Contract.

3.5 UTILIZATION OF EXCAVATION MATERIALS

****

NOTE: Specification provisions covering excavated materials authorized to be wasted will usually include the provision that the surface and side slopes formed from such material be shaped and sloped so as to provide for drainage and for later seeding and mowing operations. It is not contemplated that hand placing of coarse rock from excavation will be required except for unusual cases of embankment or channel protection. When hand placing of the coarse rock is necessary, this provision will be so stated definitely in the specifications, and the approximate amounts and locations of hand placing of coarse rock will be indicated on the plans.

****

Unsatisfactory materials removed from excavations shall be disposed in designated areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding; as backfill; and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed in designated areas approved for surplus material storage or designated waste areas as directed. Coarse rock from excavations shall be stockpiled and used for constructing slopes of embankments adjacent to streams, for constructing slopes or sides and bottoms of channels, and for protecting against erosion. Hand placing of coarse rock from excavations will not be required. Excavated material shall not be disposed in a manner as to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.6 SELECTION OF BORROW MATERIAL

****

NOTE: Where a substantial quantity of borrow excavation is anticipated, the plans and specifications will, where practicable, indicate the location or locations within the project site, and the conditions under which borrow may be obtained.

****

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas indicated on the plans or from other approved sources, either private or within the limits of the

project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay all royalties and other charges involved, and bear all expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris shall be considered related operations to the borrow excavation and shall be performed by the Contractor at no additional cost to the Government.

3.7 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

The Contractor shall give notice sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Unless otherwise permitted, borrow pits and other excavation areas shall be excavated in such manner as will afford adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed as directed. Borrow pits shall be neatly trimmed and left in such shape as will facilitate accurate measurements after the excavation is completed.

3.8 GRADING AREAS

When so provided and indicated, work under contract will be divided into grading areas, within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. Contractor shall not haul satisfactory material excavated in one grading area to another grading area, except when so directed in writing.

3.9 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; shall be plowed, disked, or otherwise broken up; pulverized; moistened or aerated as necessary; mixed; and compacted to at least [90] [_____] percent maximum density for cohesive materials or [100] [_____] percent maximum density for cohesionless materials.

****

NOTE: Specify type, number, and required load (if necessary) of compaction equipment as required by job conditions.

****

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated just prior to placement of embankment materials to ensure adequate bond between embankment material and the prepared ground surface.

3.10 EMBANKMENTS

3.10.1 Earth Embankments

****

NOTE: Change the number of inches millimeter to meet project conditions. Moisture content limits

for compaction must be included in this paragraph where considered necessary for special cases such as for controlling the movement of expansive soils or where strength values are critical.

****

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with maximum dimensions not greater than 3 inches. 75 millimeter. The material shall be placed in successive horizontal layers of loose material not more than 6 inches 150 millimeter in depth. Each layer shall be spread uniformly on a prepared surface, i.e., a soil surface that has been moistened or aerated and scarified plowed, disked, or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed, mixed, and compacted to at least [_____] percent maximum density for borrow materials or [_____] percent maximum density for excavated materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical to those requirements specified in paragraph entitled, "Subgrade Preparation."

****

NOTE: Specify type, number, and required load (if necessary) of compaction equipment as required by job conditions.

****

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment.

3.10.2 Rock Embankments

Rock embankments shall be constructed from material essentially classified as rock excavation, placed in successive horizontal layers of loose material not more than [_____] inch millimeter in depth. Pieces of rock larger than [_____] inch millimeter in greatest dimension shall not be used.

****

NOTE: The Contracting Officer will determine the appropriate values in inches millimeter on the basis of recent experience on similar construction and testing of a test section. The specified method by which density will be determined in the laboratory and measured in the field will be described in the project specification.

Delete the inapplicable sentence. Retain the following sentence if applicable to rock fill of small maximum dimension and maximum lift placement of 8 to 10 inches 200 to 250 millimeter.

****

Each layer of material shall be spread uniformly and shall be completely saturated and compacted to a density of [_____] pounds per cubic foot kilogram per cubic meter.

****

NOTE: If it is necessary to use larger rock and thicker lifts, retain the following sentence. When thicker lifts are used it may be necessary to

specify a minimum number of passes of the compactor.
****

Each layer of material shall be spread uniformly and shall be completely saturated and compacted until the interstices are filled with well-compacted materials and the entire layer is a dense, compacted mass.

Each successive layer of material shall adequately bond to the material on which it is placed.

****
NOTE: Specify type, number, and required load (if necessary) of compaction equipment as required by job conditions.
****

Compaction shall be accomplished with vibratory compactors weighing at least [_____] tons loading to at least [_____] kilograms, heavy rubber-tired rollers weighing at least [_____] tons, loading to at least [_____] kilograms, or steel-wheeled rollers weighing at least 10 tons loading to at least 9 kilograms.

Rock shall not be used above a point [_____] inch millimeter below the surface of an embankment that is to be paved.

3.11 SUBGRADE PREPARATION

3.11.1 Construction

Subgrade shall be shaped to line, grade, and cross section and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain proper compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut sections shall be excavated to a depth of 6 inches 150 millimeter below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified.

****
NOTE: When preparing specifications for preparation of roadway and airfield pavement subgrade, retain the applicable sentences and insert the smoothness tolerances, indicating permissible deviations in fractions of an inch millimeter.
****

[After rolling, the surface of the subgrade for [roadways] [and] [or] [airfields] shall indicate a deviation not greater than [_____] inch millimeter when tested with a 10-foot 3000 millimeter straightedge applied both parallel with, and at right angles to, the centerline of the area.]

Elevation of the finished subgrade shall vary not more than [_____] foot millimeter from the established grade and approved cross section.

3.11.2 Compaction

Compaction for pavements and shoulders shall be accomplished with approved equipment until the layer is compacted to the full depth to at least 95 percent maximum density.

3.12 SHOULDER CONSTRUCTION

****

NOTE: Shoulder construction will form a part of the work to be performed under this section of the specifications, except when shoulder construction is specified under the subbase, base, wearing course, or pavement sections of the specification and is designated in the contract to be performed and paid for under one of these sections.

****

Shoulders shall be constructed of satisfactory excavated or borrow materials or as otherwise indicated on the plans. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished with approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and no damage of any kind is done to the adjacent, completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section indicated.

3.13 FINISHING

Surface of excavations, embankments, and subgrades shall be finished to a reasonably smooth and compact surface substantially in accordance with the lines, grades, and cross sections or elevations indicated. Degree of finish for graded areas shall be within 1/10 foot 30 millimeter of the grades and elevations indicated, except that the degree of finish for subgrades shall be as specified. Gutters and ditches shall be finished as indicated. Surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.14 SUBGRADE AND EMBANKMENT PROTECTION

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. Finished subgrade shall not be disturbed by traffic or other operations and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. Storage or stockpiling materials on finished subgrade will not be permitted. Subbase, base course, ballast, or pavement shall not be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

-- End of Section --